## Arthroscopic Labral Reconstruction Is Superior to Segmental Resection for Irreparable Labral Tears in the Hip: A Matched-Pair Controlled Study With Minimum 2-Year Follow-up


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# Arthroscopic Labral Reconstruction Is Superior to Segmental Resection for Irreparable Labral Tears in the Hip

## A Matched-Pair Controlled Study With Minimum 2-Year Follow-up

Benjamin G. Domb,*†‡§ MD, Youssef F. El Bitar,† MD, Christine E. Stake,† MA, Anthony P. Trenga,† BA, Timothy J. Jackson,† MD, and Dror Lindner,† MD
*Investigation performed at the American Hip Institute, Chicago, Illinois*

**Background:** The acetabular labrum is an important structure that plays a significant role in proper biomechanical function of the hip joint. When the labrum is significantly deficient, arthroscopic reconstruction could provide a potential solution for the nonfunctional labrum.

**Purpose:** To compare the clinical outcomes of arthroscopic labral reconstruction (RECON) with those of arthroscopic segmental labral resection (RESEC) in patients with femoroacetabular impingement (FAI) of the hip.

**Study Design:** Cohort study; Level of evidence, 3.

**Methods:** Between April 2010 and March 2011, all prospectively gathered data for patients with FAI who underwent arthroscopic acetabular labral reconstruction or segmental resection with a minimum 2-year follow-up were reviewed. Eleven cases in the RECON group were matched to 22 cases in the RESEC group according to the preoperative Non-Arthritic Hip Score (NAHS) and sex. The patient-reported outcome scores (PROs) used included the NAHS, the Hip Outcome Score (HOS), and the modified Harris Hip Score (mHHS). Statistical analyses were performed to compare the change in PROs in both groups.

**Results:** There was no statistically significant difference between groups regarding the preoperative NAHS ($P = .697$), any of the other preoperative PROs, or demographic and radiographic data. The mean change in the NAHS was 24.8 $\pm$ 16.0 in the RECON group and 12.5 $\pm$ 16.0 in the RESEC group. The mean change in the HOS–activities of daily living (HOS-ADL) was 21.7 $\pm$ 16.5 in the RECON group and 9.5 $\pm$ 15.5 in the RESEC group. Comparison of the amount of change between groups showed greater improvement in the NAHS and HOS-ADL for the RECON group ($P = .046$ and .045, respectively). There was no statistically significant difference in the mean changes in the rest of the PROs, although there were trends in all in favor of the RECON group. All PROs in both groups showed a statistically significant improvement at follow-up compared with preoperative levels.

**Conclusion:** Arthroscopic labral reconstruction is an effective and safe procedure that provides good short-term clinical outcomes in hips with insufficient and nonfunctional labra in the setting of FAI.

**Keywords:** arthroscopic labral reconstruction; segmental labral resection; hip arthroscopic surgery; femoroacetabular impingement

The acetabular labrum is an important structure that stabilizes the hip joint and provides a seal for intra-articular lubricating fluid.[4,6,8,9] The labrum deepens the acetabular socket and ensures adequate load distribution within the hip joint.[8,9,23] Any break of the seal leads to significant pain in addition to a loss of joint fluid, which is essential in providing nutrition to the articular cartilage.[21] Furthermore, tearing of the labrum can result in an alteration of hip biomechanics, leading to the degeneration of articular cartilage and osteoarthritis (OA).[8,9,22]

Management options for labral tears have progressed over the past few years. Earlier experience in hip arthroscopic surgery involved segmental labral resection or selective debridement to relieve pain.[13,14,25] However, with the advent of biomechanical studies on the mechanical function and importance of the labrum,[6,9] labral preservation and repair started to become more prevalent with more favorable clinical outcomes.[7,13,14,25] However, when the labrum is too thin or too damaged to be adequately functional or preserved, labral reconstruction provides a good alternative in these complex cases.[20,24]

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There is an increased interest in hip arthroscopic surgery and hip preservation, especially in the young patient. However, there is a paucity in the current literature on labral reconstruction, with only 5 articles so far published. Three articles on arthroscopic labral reconstruction, 1 by Philippon et al,[24] 1 by Matsuda and Burchette,[20] and 1 by Geyer et al,[10] have shown good clinical outcomes and patient satisfaction in the short-term follow-up period. Open labral reconstruction at the time of open hip dislocations has been reported in 2 articles[27,30] with good outcomes as well, despite the short-term follow-up reported.

The purpose of this matched-pair controlled study was to compare the clinical outcomes of arthroscopic labral reconstruction (RECON) to those of arthroscopic segmental labral resection (RESEC) in patients with femoroacetabular impingement (FAI) of the hip, with a minimum 2-year follow-up. Our hypothesis was that patients who undergo reconstruction would have improved clinical outcomes and satisfaction compared with those who undergo segmental resection.

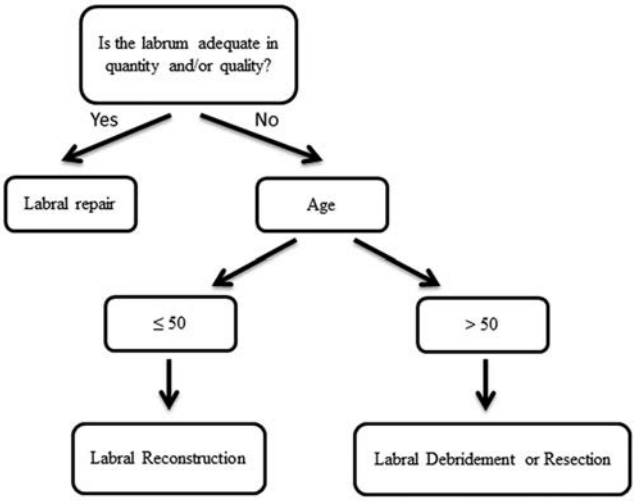


**Figure 1.** Flow diagram showing our current indications for the type of labral treatment based on whether the affected hip has no or minimal arthritis (Tönnis grade ≤1).

## MATERIALS AND METHODS

Before initiation of the study, an a priori power analysis was performed to determine the number of patients needed in both the RECON and RESEC groups to detect statistically significant differences in changes in the outcome scores. The outcome score that was chosen to perform the power analysis and matching in this study was the Non-Arthritic Hip Score (NAHS). This score has been validated[5] and reflects the patient population that we are studying,[15] more so than the modified Harris Hip Score (mHHS)[15] because the latter was designed to be applied to arthritic hips that undergo total hip arthroplasty (THA).[12,28] The Hip Outcome Score (HOS) with activities of daily living (HOS-ADL) and sports-specific subscale (HOS-SSS) was another reliable and reproducible outcome score[15-17] that could have been used in this study. However, of the 5 articles published in the literature so far on acetabular labral reconstruction (3 arthroscopic[10,20,24] and 2 open surgical dislocations[27,30]), the outcome measures that were used were the HOS,[10] NAHS,[20] mHHS,[10,24] and University of California, Los Angeles (UCLA) score.[27,30] The only study that used the HOS did not report the standard deviation values for the labral reconstruction group of patients. Therefore, a power analysis using the HOS could not be performed. Of the 3 remaining outcome scores (NAHS, mHHS, and UCLA), the NAHS was deemed to be the ideal score to be used in our study.

Matsuda and Burchette[20] published their data on acetabular labral reconstruction compared with labral refixation. They reported a mean improvement of 50.5 ± 18.85 in the NAHS in the reconstruction group and 22.5 ± 20.34 in the refixation group.[20] Using these values to perform a power analysis in our study seemed appropriate because the expected improvement after labral reconstruction in our study was expected to be close to the results published by Matsuda and Burchette.[20] On the other hand, the projected improvement after segmental labral resection in our study was expected to be less than the improvement after labral refixation that was reported in the study by Matsuda and Burchette.[20] Therefore, using the values reported by Matsuda and Burchette,[20] we performed a power analysis and found that a minimum of 9 cases was needed in each of our groups to obtain a power value of .8 with a $P$ value of .05.

Investigational review board approval was obtained before initiation of this study. At our institution, data are prospectively collected on all patients undergoing hip preservation surgery. Data include outcome scores as well as demographic and radiographic parameters. Data for all patients who underwent arthroscopic labral reconstruction or segmental resection between April 2010 and March 2011 were retrospectively reviewed. The flow diagram in Figure 1 shows our current indications for the type of labral treatment based on whether the affected hip has no or

*Address correspondence to Benjamin G. Domb, MD, American Hip Institute, 1010 Executive Court, Suite 250, Westmont, IL 60559 (e-mail: DrDomb@americanhipinstitute.org).
†American Hip Institute, Chicago, Illinois.
‡Hinsdale Orthopedics, Hinsdale, Illinois.
§Loyola University Stritch School of Medicine, Chicago, Illinois.

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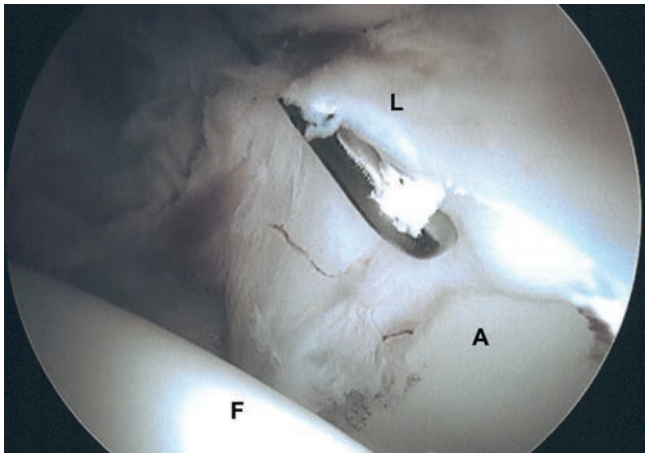


**Figure 2.** Arthroscopic view of an irreparable complex tear of the acetabular labrum (L). A, acetabulum; F, femoral head.

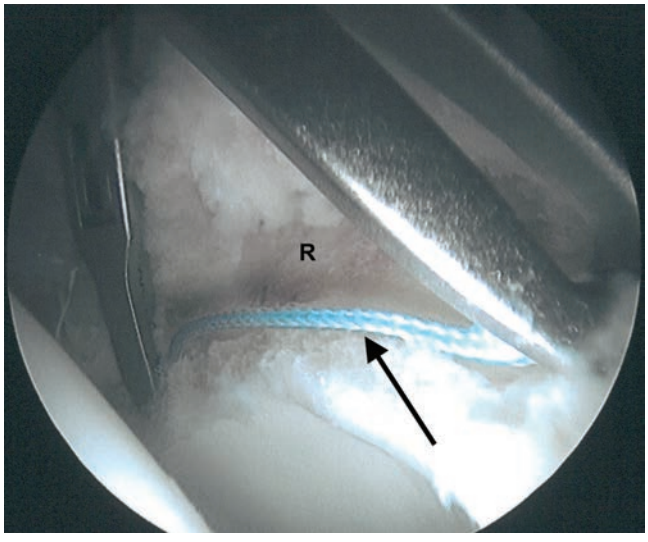


**Figure 3.** Arthroscopic view of the acetabular rim (R) prepared for placement of the labral graft. The FiberWire (arrow) is used to measure the length of the defect.

**Figure 4.** An arthroscopic acetabular measuring probe.

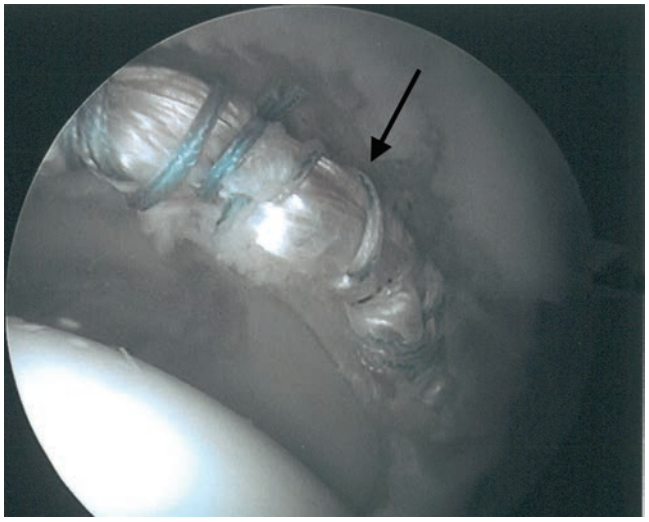

**Figure 5.** Arthroscopic view of the reconstructed acetabular labrum (arrow) using a gracilis tendon autograft.

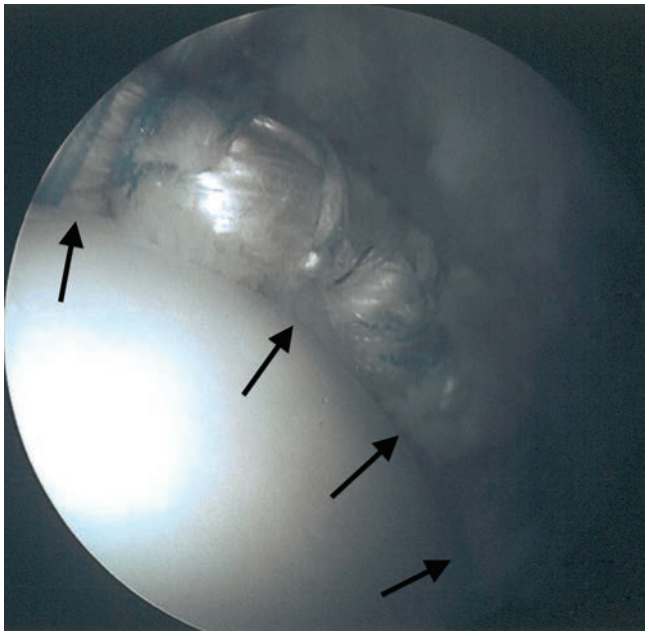

**Figure 6.** Arthroscopic bird's-eye view showing the gracilis tendon graft forming the seal effect around the femoral head (arrows).

minimal arthritis (Tönnis grade $\leq$1). The labrum was repaired in all cases when it was adequate in quantity and/or quality. When the labrum was deficient in quantity and/or quality, labral reconstruction was performed when the patient's age was $\leq$50 years, and resection was performed when the patient's age was $>$50 years. Inclusion criteria were patients who underwent arthroscopic labral reconstruction or segmental resection in the hip, were $\geq$18 years of age, had concomitant acetabuloplasty $\pm$ femoral osteoplasty for symptomatic FAI, and had no significant arthritic changes in the hip (Tönnis grades 0 or 1).

Included patients had a minimum of 2-year follow-up and had completed the following patient-reported outcome scores (PROs): the NAHS, HOS-ADL and HOS-SSS, mHHS, and visual analog scale (VAS) for pain preoperatively and at a minimum 2-year follow-up. Patients with dysplasia were excluded from this study as well as those who refused to participate in the follow-up. Patient satisfaction was also reported on a scale from 0 to 10, with 0 being highly dissatisfied and 10 being highly satisfied. Short- and long-term complications were recorded at both the site of surgery (hip) and the site of graft harvest (ipsilateral knee). End points such as conversion to THA or resurfacing arthroplasty and revision arthroscopic surgery for any reason were also reported.

A total of 11 cases of arthroscopic labral reconstruction met the inclusion criteria. These were group matched with 22 cases (of 44 cases) of arthroscopic segmental labral resection that met the same inclusion criteria. Matching was performed by a separate observer who was blinded to all data except the type of labral surgery (reconstruction or resection), sex, and preoperative NAHS. There is no consensus on the criteria for matching in the literature (number of variables needed and range for each variable). In the current study, matching was performed according to the preoperative NAHS (because the NAHS was used for a priori power analysis) and sex. Patients who have lower preoperative NAHS values have more room for improvement in their scores (up to a maximum of 100) compared with patients who have higher baseline scores. Therefore, matching according to the preoperative NAHS was considered the most important matching parameter. This method will allow the matched patients to start at the same baseline level and will allow a direct comparison between the magnitudes of change ($\Delta$) in their scores after surgery, which would give a more accurate representation of the results than comparing absolute postoperative scores in both groups.

## Surgical Technique

Surgery was performed with the patient in the supine position on a traction table. The anterolateral portal (AP) was used for viewing using a 70° arthroscope, and the midanterior portal (MAP) was used as a working portal. Diagnostic arthroscopic surgery was performed initially for the whole joint. When the labrum was deemed to be nonfunctional and unsalvageable (complex tear, segmental loss, calcified or hypotrophic), labral reconstruction was undertaken (Figure 2). The AP was used to resect the nonfunctional part of the diseased labrum until healthy labrum edges were achieved. The size of the defect was measured by superposing a FiberWire suture (Arthrex Inc, Naples, Florida) over the rim of the acetabulum and measuring its length (Figure 3). Alternatively, an arthroscopic acetabular measuring probe may be used for the measurement (Figure 4). Acetabuloplasty was then performed as part of rim reduction surgery for pincer-type impingement or to prepare the bed for labral reconstruction.

At this point, all instruments were withdrawn from the joint, traction was released, and graft harvest was undertaken. Several graft choices were available for reconstruction including autografts and allografts. The gracilis tendon autograft was used because of its strong tensile properties and ease of harvest. Alternatively, the semitendinosus tendon could have been used. The iliotibial band (ITB) was not used because of a concern that disrupting its fibers may alter the mechanics of the hip and complicate recovery from hip arthroscopic surgery. For this reason, we preferred a graft donor site that was separate from the operative area geographically. The gracilis tendon was harvested from the ipsilateral knee using the standard technique. The graft was then prepared in a doubled-over fashion with Krackow stitches to a length of approximately 2 mm longer than the measured defect length on each side.

Traction was then reapplied, and a third portal, the distal accessory anterior portal (DAAP), was created and used to drill the anchor sites at 5- to 8-mm intervals. Disposable cannulas were then placed in the AP and DAAP. One of the end sutures on the end of the graft was used to lead the graft into the joint through the MAP. Knotless anchors were used to secure the graft to the acetabular rim. The anterior end of the graft was anchored at the anterior edge of the site of segmental loss of the labrum using a 2.9-mm PushLock anchor (Arthrex Inc). The posterior end of the graft was anchored to the most lateral aspect of the labral defect. The anchors at each end of the graft were placed just superior to the end of the intact native labrum to accomplish some overlap. In this manner, gaps between the native labrum and graft were avoided. The middle portion of the reconstructed labrum was then anchored to the rest of the predrilled holes on the acetabular rim using a simple loop technique (Figure 5). Traction was released, and a bird's-eye view was taken of the reconstructed labrum, demonstrating a visually appropriate initial fluid seal effect that would potentially allow for healing and scar tissue to take place and establish a comparable fluid seal effect to the native intact labrum (Figure 6). Attention was then turned to the peripheral compartment, where femoral osteoplasty and/or capsular repair was undertaken if deemed necessary.

Postoperative rehabilitation included wearing a hip brace locked to allow 0° to 70° of hip flexion. The brace was worn for 6 weeks in cases of labral reconstruction and for 2 weeks in cases of labral resection, allowing for 20-lb flat-foot weightbearing using crutches. Hip range of motion exercises were started on postoperative day 1 with either 4 hours in a continuous passive motion machine or 2 hours on a stationary bike. The brace was taken off at 6 weeks, with full hip range of motion allowed as tolerated as well as weaning off crutches as tolerated.

## Statistical Analysis

The IBM SPSS Statistics version 20 software (IBM Corp, Armonk, New York) was used to perform all the statistical analyses in this study. The means ± standard deviations for age, body mass index (BMI), traction time, follow-up time, $\alpha$ angle, crossover percentage, lateral center edge angle (LCEA), preoperative and last follow-up PROs, and patient satisfaction were calculated. The paired Student *t* test was used to compare the preoperative to last

TABLE 1
Baseline Demographic and Radiographic Variables, Baseline Outcome Scores, and Operative Variables for the Reconstruction and Resection Groups[a]

| | Reconstruction Group | Resection Group | *P* Value |
|---|---|---|---|
| Age, y | 33.0 ± 9.9 (18.0-44.9) | 38.8 ± 6.6 (23.3-48.5) | .055 |
| Sex, male/female | 7/4 | 14/8 | 1.000 |
| BMI | 24.5 ± 3.0 (21.5-30.5) | 27.1 ± 4.4 (20.3-36.0) | .082 |
| α angle, deg | 56.4 ± 13.5 (34.0-80.0) | 58.7 ± 9.7 (46.0-84.0) | .567 |
| Crossover percentage | 17.3 ± 13.5 (0.0-40.0) | 9.5 ± 14.0 (0.0-50.0) | .140 |
| LCEA, deg | 33.2 ± 2.2 (29.0-35.0) | 32.1 ± 3.4 (27.0-38.0) | .360 |
| Tönnis grade 0/grade 1 | 8/3 | 15/7 | 1.000 |
| Traction time, min | 91.1 ± 17.1 (70.0-127.0) | 77.5 ± 17.5 (30.0-120.0) | .042 |
| Follow-up, y | 2.2 ± 0.3 (2.0-2.7) | 2.5 ± 0.5 (2.0-3.6) | .133 |
| Preoperative outcome score | | | |
| NAHS | 52.9 ± 16.8 (25.0-79.0) | 55.5 ± 18.8 (13.0-81.3) | .697 |
| HOS-ADL | 58.6 ± 13.9 (29.0-72.0) | 64.7 ± 20.5 (16.0-91.2) | .380 |
| HOS-SSS | 38.7 ± 22.6 (9.0-78.0) | 44.8 ± 23.0 (0.0-75.0) | .477 |
| mHHS | 54.5 ± 26.1 (2.0-85.0) | 59.2 ± 18.4 (25.0-95.7) | .560 |
| VAS | 6.5 ± 2.1 (3.0-9.0) | 6.9 ± 1.7 (4.0-10.0) | .592 |

[a]Data are expressed as mean ± standard deviation (range). BMI, body mass index; HOS-ADL, Hip Outcome Score–activities of daily living; HOS-SSS, Hip Outcome Score–sports-specific subscale; LCEA, lateral center edge angle; mHHS, modified Harris Hip Score; NAHS, Non-Arthritic Hip Score; VAS, visual analog scale for pain.

follow-up values of all the PROs in both groups. The independent Student *t* test was used to compare the means of both groups in regard to age, BMI, traction time, follow-up time, α angle, crossover percentage, LCEA, baseline preoperative PROs, last follow-up PROs, and amount of change in the PROs. The Fisher exact test was used to compare the Tönnis grade in both groups as well as the number of femoroplasties for cam-type impingement. A *P* value of $<.05$ was considered to be statistically significant for all the statistical analyses.

## RESULTS

There was no statistically significant difference between groups in regard to the preoperative NAHS ($P = .697$), any of the other preoperative PROs, or any of the demographic or radiographic data (Table 1). All patients in both groups underwent acetabuloplasty for pincer-type impingement. Eight of 11 patients underwent femoroplasty for cam-type impingement in the RECON group and 20 (of 22) in the RESEC group ($P = .304$). Traction time was longer in the RECON group ($P = .042$). In the RECON group, 8 cases had combined cam/pincer-type FAI, and 3 had isolated pincer-type FAI. In the RESEC group, 20 cases had combined cam/pincer-type FAI, and 2 had isolated pincer-type FAI. In the RECON group, 6 cases were revision arthroscopic surgeries, and 5 were primary arthroscopic surgeries. Of the 6 revision cases, 3 cases underwent arthroscopic surgery twice before the reconstruction and 3 cases only once. In the RESEC group, 5 cases were revision arthroscopic surgeries, 1 case had an open proximal ITB release performed previously for external snapping, and 16 cases were primary arthroscopic surgeries. All 5 cases of revision arthroscopic surgeries had previously undergone 1 primary arthroscopic surgery. The gracilis tendon autograft was used for labral reconstruction in all cases.

Comparing satisfaction in both groups showed no statistically significant difference ($P = .512$) (Figure 7), with 72.7% showing subjective good to excellent satisfaction (satisfaction $\geq 7$) in the RECON group and 63.6% in the RESEC group. The follow-up PROs in both groups showed mean values for the NAHS of 77.6 ± 13.5 for the RECON group and 68.0 ± 25.0 for the RESEC group ($P = .245$), the HOS-ADL of 80.3 ± 14.0 for the RECON group and 74.2 ± 24.6 for the RESEC group ($P = .455$), the HOS-SSS of 60.1 ± 32.0 for the RECON group and 54.1 ± 32.2 for the RESEC group ($P = .617$), the mHHS of 81.6 ± 13.7 for the RECON group and 73.1 ± 20.8 for the RESEC group ($P = .230$), and the VAS of 2.9 ± 1.8 for the RECON group and 4.1 ± 2.7 for the RESEC group ($P = .202$) (Table 2).

The mean change in the NAHS was 24.8 ± 16.0 in the RECON group and 12.5 ± 16.0 in the RESEC group. Comparison between the amount of change in both groups showed a statistically significant difference in favor of the RECON group ($P = .046$) (Figure 7). The mean change in the HOS-ADL was 21.7 ± 16.5 in the RECON group and 9.5 ± 15.5 in the RESEC group. Comparison between the amount of change in both groups showed a statistically significant difference in favor of the RECON group ($P = .045$). There was no statistically significant difference between the mean changes in the rest of the PROs (HOS-SSS, mHHS, and VAS), despite having more improvement in scores in the RECON group (Figure 7). All PROs showed a statistically significant improvement at follow-up compared with preoperatively as outlined in Table 2.

No intraoperative complications occurred in any of the groups. Two patients in the RECON group had medial knee pain at the graft harvest site that resolved at 6 weeks' follow-up. One patient in the RECON group (who

TABLE 2
Comparison of Preoperative and Postoperative Outcome Scores for the Reconstruction and Resection Groups[a]

| | Reconstruction Group | | | Resection Group | | |
|---|---|---|---|---|---|---|
| | Preoperative | Follow-up | *P* Value | Preoperative | Follow-up | *P* Value |
| NAHS | 52.9 ± 16.8 (25.0-79.0) | 77.6 ± 13.5 (58.8-97.5) | <.001 | 55.5 ± 18.8 (13.0-81.3) | 68.0 ± 25.0 (17.5-100.0) | .001 |
| HOS-ADL | 58.6 ± 13.9 (29.0-72.0) | 80.3 ± 14.0 (60.9-98.5) | .001 | 64.7 ± 20.5 (16.0-91.2) | 74.2 ± 24.6 (22.9-100.0) | .009 |
| HOS-SSS | 38.7 ± 22.6 (9.0-78.0) | 60.1 ± 32.0 (0.0-100.0) | .042 | 44.8 ± 23.0 (0.0-75.0) | 54.1 ± 32.2 (0.0-100.0) | .043 |
| mHHS | 54.5 ± 26.1 (2.0-85.0) | 81.6 ± 13.7 (57.1-100.0) | .012 | 59.2 ± 18.4 (25.0-95.7) | 73.1 ± 20.8 (25.3-100.0) | .001 |
| VAS | 6.5 ± 2.1 (3.0-9.0) | 2.9 ± 1.8 (1.0-7.0) | .001 | 6.9 ± 1.7 (4.0-10.0) | 4.1 ± 2.7 (0.0-10.0) | <.001 |

[a]Data are expressed as mean ± standard deviation (range). HOS-ADL, Hip Outcome Score–activities of daily living; HOS-SSS, Hip Outcome Score–sports-specific subscale; mHHS, modified Harris Hip Score; NAHS, Non-Arthritic Hip Score; VAS, visual analog scale for pain.

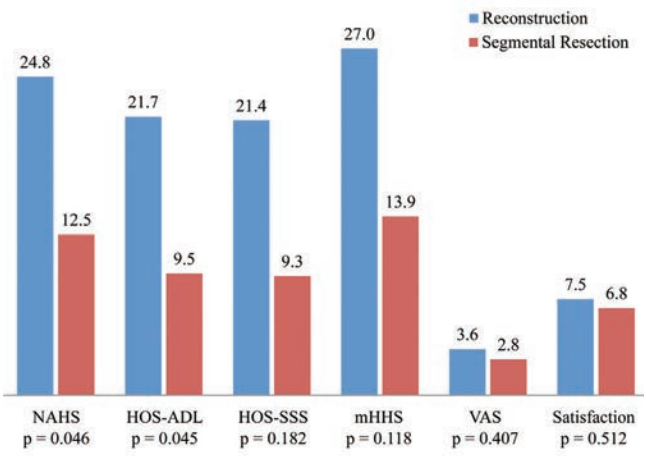


**Figure 7.** Comparison of change in the outcome scores and satisfaction between the reconstruction and resection groups. HOS-ADL, Hip Outcome Score–activities of daily living; HOS-SSS, Hip Outcome Score–sports-specific subscale; mHHS, modified Harris Hip Score; NAHS, Non-Arthritic Hip Score; VAS, visual analog scale for pain.

underwent 2 arthroscopic surgeries before the reconstruction) underwent revision arthroscopic surgery for hip pain after trauma at 1.3 years after the reconstruction (Figure 8). The reconstructed labrum was found to completely adhere to the acetabular rim, with an intact chondrolabral junction. However, there was some softening of the acetabular cartilage adjacent to the reconstructed labrum (Figure 8). Two patients in the RESEC group had superficial wound infections that were treated successfully with oral antibiotics. Two patients in the RESEC group underwent revision arthroscopic surgeries for subsequent hip injuries at 2 years and 3 years after the primary arthroscopic surgery. One patient in the RESEC group, who initially underwent revision arthroscopic surgery at our institution, had postoperative adhesive capsulitis that failed nonoperative treatment of physical therapy and steroid injection. This patient underwent revision arthroscopic surgery at 9 months. All 3 patients who

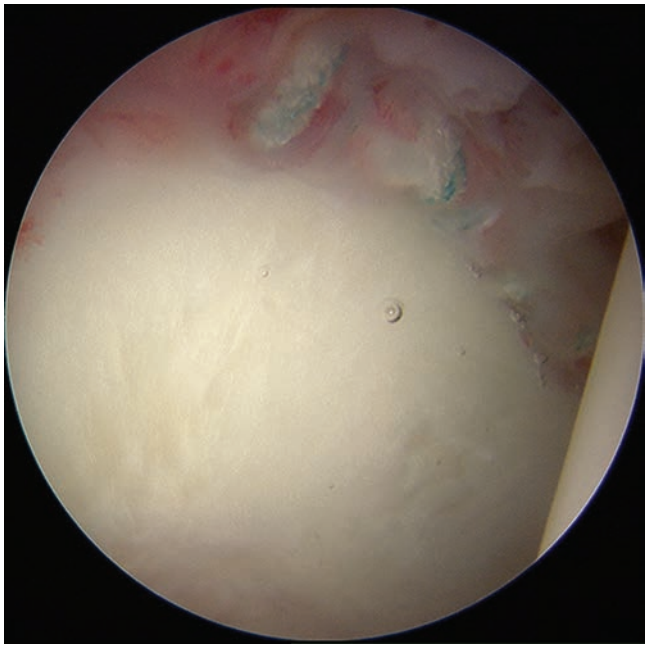

**Figure 8.** Arthroscopic view showing the reconstructed labrum looking adequately healed with scar tissue covering most of the sutures and no evidence of tears.

underwent revisions in the RESEC group had friable scar tissue at the area of previous labral resection. None of the patients was lost to follow-up. None of the patients had undergone or was scheduled for THA or resurfacing arthroplasty.

## DISCUSSION

The current study is, to our knowledge, the first comparative study between arthroscopic labral reconstruction and segmental resection in hips with FAI. Both techniques resulted in statistically significant improvement in all outcome measures at a minimum 2-year follow-up (Table 2). Both groups had similar baseline PROs ($P > .005$ for all), with a trend toward lower scores in the RECON group.

However, comparing the change in PROs in both groups of patients showed statistically significant superior changes in outcome scores after reconstruction in both the NAHS and HOS-ADL (Figure 7). The rest of the PROs (mHHS and HOS-SSS), the VAS score, and patient satisfaction showed more improvement in the RECON group; however, they did not reach statistical significance (Figure 7). Both the VAS score and patient satisfaction are objective results that need to be accompanied by more objective scoring systems such as the PROs for clinical significance. Comparing reconstruction to segmental resection would be the ideal scenario in our opinion. In the nonarthritic hip, when the labrum is too thin or too damaged to be adequately functional or preserved, there are only 2 options for surgical management: resection or reconstruction. Therefore, a direct comparison between these 2 techniques would provide meaningful conclusions.

There is an increased interest in labral preservation over the past several years because of the work of pioneers in the field of hip arthroscopic surgery. Several biomechanical studies have shown that labral tears cause a significant disruption in hip kinematics and eventually lead to chondral damage and early-onset OA.[6,9,11,29] Therefore, there has been more attention directed at labral preservation in an attempt at delaying the occurrence of OA in the young patient.[3] Recent clinical outcome studies have shown improved outcomes after labral repair compared with labral debridement or segmental resection.[7,14,25] At our institution, all types of labral surgery (segmental resection, selective debridement, repair and reconstruction) have been used in the past because of the lack, at that time, of concrete evidence for the superiority of one technique over the other. Therefore, segmental labral resection was one of those techniques used in the past, which has become less frequent in our current practice, except in patients with more intraoperative arthritic changes than were expected preoperatively and in patients older than 50 years (Figure 1). Moreover, labral reconstruction is still a new technique under investigation with very limited short-term clinical outcomes.

Described techniques for labral reconstruction varied in the literature with the use of different types of grafts. These include harvested grafts such as the ITB,[10,24] gracilis tendon,[19,20] or semitendinosus tendon[18] or local tissue that is close enough to provide a stable rim of the reconstructed labrum, including the reflected head of the rectus femoris muscle,[18] the adjacent capsule,[18] or the chondrolabral junction/pseudolabrum area.[18]

Matsuda and Burchette[20] performed a retrospective study comparing 8 cases of arthroscopic acetabular labral reconstruction (RECON) using a gracilis tendon autograft to 46 cases of arthroscopic labral refixation (REFIX). Both groups showed a statistically significant improvement in the NAHS. Comparing both groups for the amount of change in the NAHS showed significantly better improvement in the RECON group ($P = .002$). However, baseline NAHS values were significantly lower in the RECON group to start with ($P = .04$), which can be related to the small sample size. When the 8 patients in the RECON group were matched to 8 (of the 46) patients in the RESEC group, there was no statistically significant difference in the change in the NAHS in both groups ($P = .11$).[20] There are no strict criteria for matching patients in a comparative study. However, matching patients according to baseline NAHS values would give both groups the same amount of possible improvement, making the comparison more relevant. Moreover, patients who ended up with reconstruction had lower preoperative NAHS values,[20] which seems understandable given the fact that these patients had nonfunctional or severely damaged labra as compared with patients who ended up with refixation. Therefore, comparing patients with severely damaged or nonfunctional labra from the beginning (patients who end up with reconstruction compared with those who end up with segmental resection) would provide a better understanding about the efficacy of labral reconstruction.

The pioneer study in arthroscopic acetabular labral reconstruction was published by Philippon et al[24] using an ITB autograft. There were 47 patients available for review with a minimum 1-year follow-up, 23 (49%) of whom underwent previous surgeries to the involved hip and 4 (9%) progressed to THA. Mean improvement was 23 points in the mHHS and a median patient satisfaction value of 8 of 10. Patients younger than 30 years had better outcomes and satisfaction, and patients with a joint space width of less than 2 mm had lower satisfaction scores.[24] This study, however, did not have any control group for comparison, and the follow-up was only short term (minimum, 12 months). Geyer et al[10] published another case series with a longer minimum follow-up (3 years) on the same patient population, with 76 cases included, 19 of which ended up with arthroplasty at a mean of 28 months. Forty-nine cases with no THA were available for a mean follow-up of 49 months, with statistically significant improvements in the PROs. A joint space width of $\leq$2 mm was associated with a higher chance of requiring arthroplasty and was considered a poor prognostic factor for survival of the hip after labral reconstruction.[10]

Two other studies from one institution[27,30] were published on labral reconstruction at the time of open surgical dislocations for the treatment of FAI. The first study[27] was a case series of 5 hips, with a minimum follow-up of 5 months and improvement in the mean UCLA score from 5 to 8.2. One hip was converted to THA at 20 months. The small sample size, short-term follow-up, and lack of a control group limit conclusions. The second more recent study[30] included 20 hips, with a minimum follow-up of 12 months. Three hips were converted to THA, and of the remaining 17 hips, the mean UCLA score at follow-up was 8.5, with subjective improvement in pain and function. Of the 20 hips, 13 underwent a reoperation at least once. The authors concluded that clinical improvements were likely the result of correction of structural deformities, and they could not discern if any benefit was attributed to labral reconstruction.[30] Performing hip arthroscopic surgery with concomitant labral reconstruction and femoroacetabular osteoplasty precludes the need for surgical dislocations, prevents the need for subsequent removal of hardware, and provides faster recovery.[2,26]

One interesting study recently published by Abrams et al[1] reported on the potential for the labrum to regenerate

after debridement. Concomitant hip arthroscopic surgery with removal of trochanteric hardware was performed in 24 hips at 2 years after open hip surgical dislocations with labral debridement as part of FAI surgery. The authors reported that at the time of arthroscopic surgery, the labrum demonstrated regrowth in 21 hips, with a mean Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) score of 98 points at 11-year clinical follow-up.[1] However, defining the boundary between the labrum and scar tissue is challenging, especially when there is significant overlap in the transitional zone between the labrum and scar tissue, which makes it difficult to judge exactly if there was regeneration and to what extent.

Cadet et al[4] described the fluid seal properties of the acetabular labrum in a cadaveric study. They found that the fluid seal was functioning best with an intact labrum. They also noted that a repaired labrum maintained a better fluid seal than a labral tear, reconstruction, or resection.[4] Despite their findings, it is difficult to know whether effective reproduction of the fluid seal effect was achieved with their reconstruction technique. In addition, at time zero, there may indeed be weakness of the fluid seal using any reconstruction technique. However, our technique for reconstruction involved examination of the seal against the femoral head after removing traction. In most cases, we were able to reproduce what visually appeared as an excellent seal against the femoral head. We would hypothesize that healing and scar tissue formation must take place before the fluid seal can truly be re-established.

We propose general guidelines to direct decision making when faced with a complex case with a deficient and nonfunctional labrum. Patient selection is of utmost importance. The ideal patient for labral reconstruction would be a young, active patient younger than 50 years, with no arthritis detected preoperatively or intraoperatively (Figure 1). Joint space narrowing and arthritis are considered contraindications for hip arthroscopic surgery in general and apply to labral reconstruction as well.[10,20,24] Younger patients tend to have more clinical improvements after labral reconstruction.[24] Patients who undergo revision hip arthroscopic surgery have an increased chance of needing labral reconstruction. One study reported that 49% of labral reconstruction cases were revisions.[24] Of our 11 reconstruction cases, 6 were revisions (54.5%) in which we anticipated the need to reconstruct the labrum because of the lack of improvement after previous labral debridement or segmental resection. Therefore, we routinely include labral reconstruction in patient education and consent preoperatively.

The main strengths of this study are the inclusion of a matched control group of segmental labral resection with similar baseline characteristics for demographic data, radiographic data, and baseline PROs. This study was also powered a priori. Surgeries were performed by the same surgeon within the same time period, with a minimum 2-year follow-up. Limitations of this study include a small sample size and lack of postoperative imaging data. Matching by itself can introduce bias to any study, despite having 1 blinded observer match the data in this study.

## CONCLUSION

Arthroscopic labral reconstruction using a gracilis tendon autograft is an effective and safe procedure that provides good short-term clinical outcomes in hips with insufficient and nonfunctional labra in the setting of FAI. This study adds to the growing literature on this procedure and suggests that in the setting of an irreparable labral tear, reconstruction may be superior to segmental labral resection.

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